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EXECUTIVE FUNCTIONS AS REFLECTED BY DIFFERENT LEVELS OF ATTENTION

Summary of the Ph.D. Thesis

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Introduction

A lot of concepts have been emerged regarding the development and definition of attention having a complex cognitive nature. In currently used classification system the developmental disorder of attention is labeled as inattention and according to diagnostic manual (DSM-IV; BNO-10) often co-occurs with impulsive, hyperactive behavior. In the literature we often meet the ADHD terminology, which is a result of acronym of Attention Deficit Hyperactivity Disorder.

ADHD is a common childhood disorder characterized by early appearance, stability and gravity of symptoms regarding inattention, hyperactivity and impulsivity (Swanson et al., 1998). The diagnosis of the disorder is difficult because these children at behavioral level differ from typically-developing children only in intensity, stability and the grouping of the symptoms (Johnson, 1997). The ADHD might negatively influence the children's behavior, their social competence and might cause school failure (Sciutto, Terjesen and Frank, 2000).

Regarding the disorder's causes a lot of theories have been emerged, the neuropsychology's rapid progress seems to prove the earlier idea that the ADHD can be linked to the frontostriatal dysfunctions (Berger et al., 2007; Csépe 2005; Durston et al., 2003; Rubia, 2011). In every day life diagnosis we aren't able to use that kind of brain imaging techniques which could figure out these dysfunctions. In parallel with mapping of brain's activities there are efforts to grab the main behavior signs as well. However not all scientists agree with this theory, the results seems to prove that in the case of ADHD we meet impaired executive functions located in the frontal lobe. Among the scientists who maintain this theory there are also contradictions regarding which aspect of executive functions is concerned. So there isn't a standard concept regarding which kind of neuropsychological tests could identify the disorder (Willcutt and Carlson, 2005; Graham, Seth and Coghill, 2007), there is also a debate regarding the combination of the tasks from a testbattery (Naglieri et al., 2005). There still doesn't exist a standard and accepted diagnostic system which could efficiently differentiate among people, which could result in a precise and reliable diagnosis that would lead to early identification and prevalence.

Deficits in executive function in case of ADHD raised the question regarding the connection between ADHD and intelligence. Low intelligence level is considered by some authors to be a particularity of the disorder (Frazier, Demaree and Youngstrom, 2004) while others state that ADHD specific disorders are independent of g factor[1], so the difference cannot be taped in the full scale IQ (Crinella and Yu, 2000; Jepsen and Mortensen, 2008; Schuck and Crinella, 2005).

The aim of this study is to evaluate the different aspects of executive functions, to give a detailed mapping of comprehensive intelligence structure so hereby to draw the ADHD's specific cognitive profile. In the study beside the children with ADHD and typically-developing children also participated children whose inattentiveness – although didn't reach the clinical level – was higher than that of the control group. This enables us to reveal how the different levels of attention problems manifest in cognitive functions studied by us.

Problem raising, main issues

Due to the controversial results that can be found in the literature we didn't intend to test pre-set hypotheses, we try to find answers to some questions which have been occurred on the basis of previous researches' results.

The results have been analyzed along three main issues:

1. Taking into consideration that injuries of prefrontal cortex and impaired executive functions do not imply weakened intelligence abilities (Williams and Mateer, 1992,

[1] The terminology belongs to Spearman (1904), marking a general factor which contributes to all intelligence abilities (Márkus, 2007)

Marlowe, 1992, cited by Csépe, 2005; Baron, 2004) and on the other hand some of the tasks in intelligence tests used for profile drawing are based on executive functions, our first question *is whether the different levels of attention functions could or not be grabbed along intelligence profile*. *Could such group specialties be found that could help differential diagnosis*?

2. Researches supporting the impaired functions of frontostriatal system (Berger et al., 2007; Csépe 2005; Durston et al., 2006; Rubia, 2011), the controversial results of executive functions (Pasini et al., 2007; Holmes et al., 2010; Williams et al., 2010; Tehrani-Doost et al., 2007; Jonsdottir et al., 2006; Di Trani et al., 2011) and earlier results regarding the fact that if the IQ and the age are under control the group differences that previously could be observed disappear (Scheres et al., 2004) – these results led us to our second question. *Can we find any differences of executive functions on behavioral level in the case of ADHD* while controlling the effects of IQ? In case the answer is yes the next question is: *which are those aspects of executive functions where these differences can be detected*? On the other hand we also try to get an answer to the question whether *attention problems' rates could be detected in the cognitive profile of executive functions*?
3. Taking into consideration that our aim is to map cognitive specialties of people with different attention problems the third question is: *are the groups formed according to the results obtained in continuous performance tests* (developed for examining the sustained attention) *the same as the initial ones formed on the basis of conventional diagnostic criteria*? In case the answer is negative new questions arise:
    a. *What are the causes of these differences*?
    b. *Could the new groups – formed on the bases of different pattern of results obtained in vigilance test – be described by a special cognitive profile along the other aspects of executive function*?

Participants, materials

In this study participated children with a clinical diagnosis of ADHD aged between 8-11 and besides them there were children matched in age, grade, sex and SES (mother's school grade) in the control group and also pupils whose attention level was on the borderline forming the subclinical group.

In the study the following tests were used: WISC-IV[2], CBCL[3], 3DM-H screening[4] and a part of the PEBL software package available on the internet measuring the executive functions developed by Mueller (2012).

Due to the frequent comorbidity of ADHD and dyslexia we excluded those children whose accuracy and/or fluency in reading words and nonwords was below the average level with at least 2 standard deviations. This was realized with the help of the computer based 3DM (Dyslexia Differential Diagnosis, Maastricht) examination's Hungarian version, namely with its reading screening part. It was followed by intelligence test. In the case of children who met all inclusive criteria the next step was to solve the computer based tasks. A child's complete examination was realised individually in three sessions and it took aproximately two and a half or three hours.

In the group of ADHD there were included those children who had a former diagnosis of ADHD based on the DSM-IV criteria made by a psychiatrist; their reading performance and intelligence quotient were average.

[2] Wechsler Intelligence Scale for Children, Hungarian adaptation: Bass et al, 2008
[3] Children Behaviour Check List developed by Achenbach – Hungarian version: Rózsa, Gádoros and Kő, 1998.
[4] Developed by Leo Blomert and Anniek Vaessen – Hungarian version: Copyright Csépe V., Tóth D., Vaessen A., Blomert L., 2009. The adaptation of test is being worked out.

In the subclinical group there were included those children whose attention scale rating measured with the help of CBCL was above the average level with 1 standard deviation, obtaining a t-score between 60-70. At the same time their reading performance and intelligence quotient were average.

In the control group there were included those children whose attention scale rating measured with the help of CBCL was average and they had an average score in reading words and nonwords and their IQ was also average.

28 children with ADHD corresponded to our inclusion criteria and there were matched 28 control and 28 subclinical children. Thus data analysis was done on the base of 84 pupils' results.

Results

Evaluating the results first we analyzed the differences and similarities among the initially formed groups. We also tried to find out whether the conventional diagnosis established by psychiatrists and the results of the continuous performance tests measuring the vigilance of attention are or not identical. For the sake of this target clusteranalyse was made on the bases of vigilance tasks, its results are shown on the next figure (see Fig. 1).

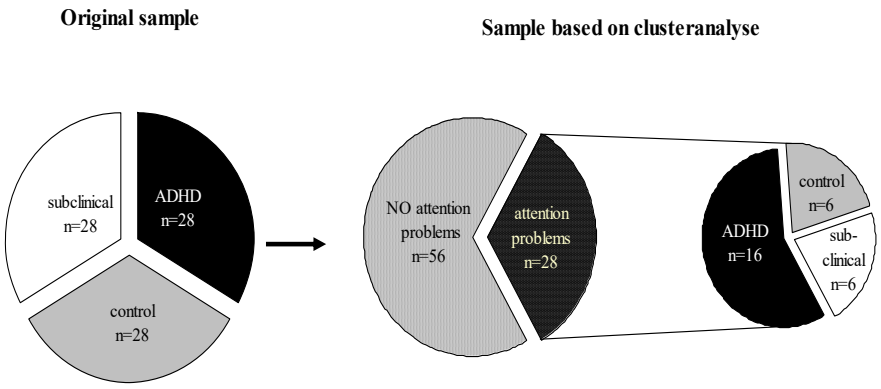
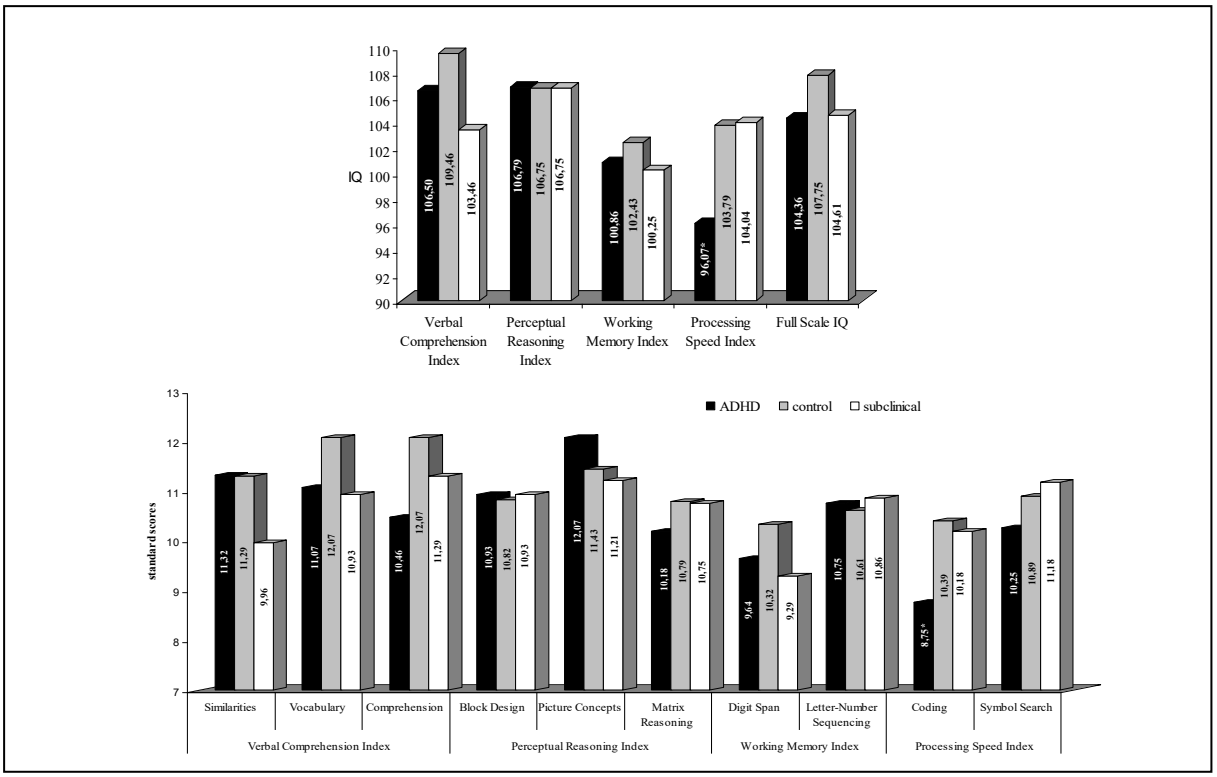


Fig. 1. – *The original sample and the sample based on clusteranalyse*

The clusteranalyse was made on the bases of vigilance tasks so two separate groups were obtained, one of them including those having attention problems (henceforth AP), and the other one including those without attention problems (henceforth control). The groups formed on the basis of clusteranalyse were repeatedly compared along the intelligence structure and executive functions.

The results of the intelligence test

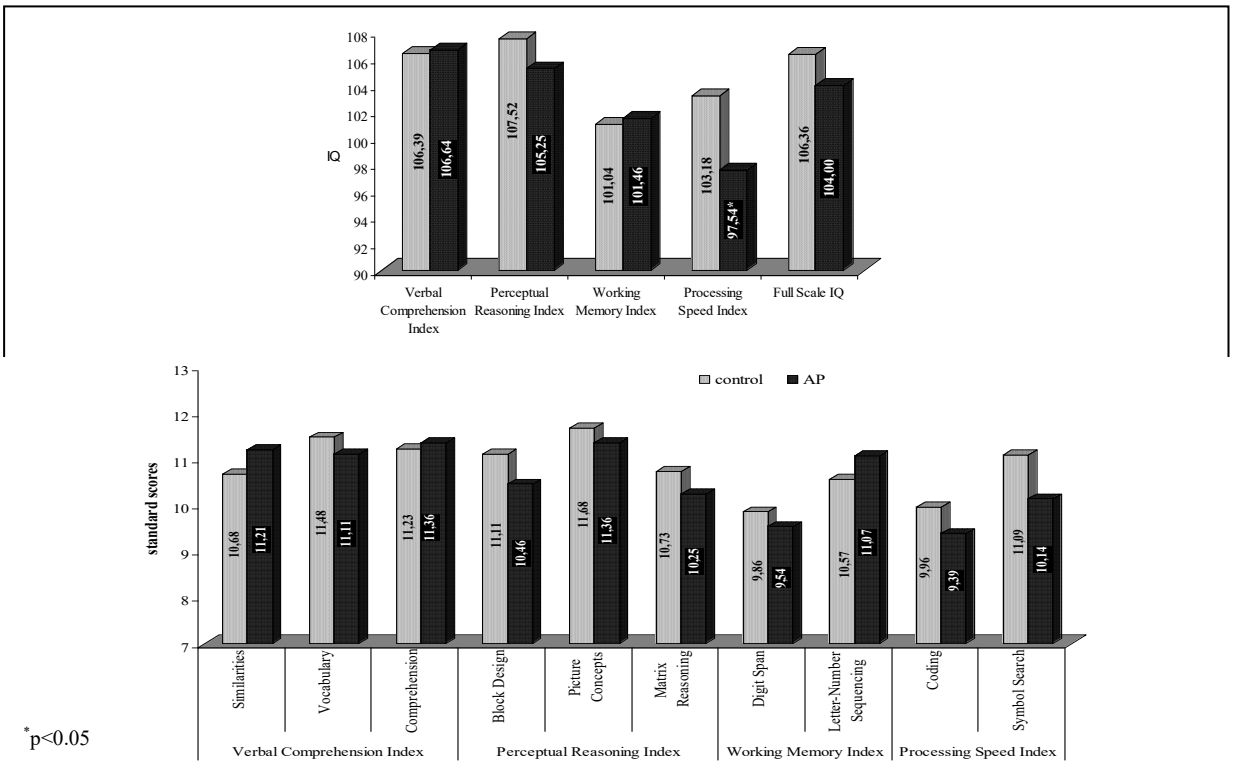
Among the initially formed groups significant differences can be found only in Processing Speed Index (PSI) according to the WISC-IV indexes. The ADHD group was significantly slower in PSI compared to control and subclinical groups while the later two groups obtained statistically same results. Comparing the results obtained in the subtests significant difference appears only in the Coding subtest belonging to PSI. The comparisons of the three groups indicated that only between ADHD and control group emerges a significant difference, while between ADHD and subclinical group there is only a tendency for differences (see Fig. 2.).



*p<0.05

Fig. 2. – *Original group's comparison on WISC-IV index and subtests*

According to the results obtained after clusteranalyse the same pattern can be seen. The attention problems group compared to control group obtained significant lower score in Processing Speed Index. In the case of subtests there can be observed no significant difference (See Fig. 3.).



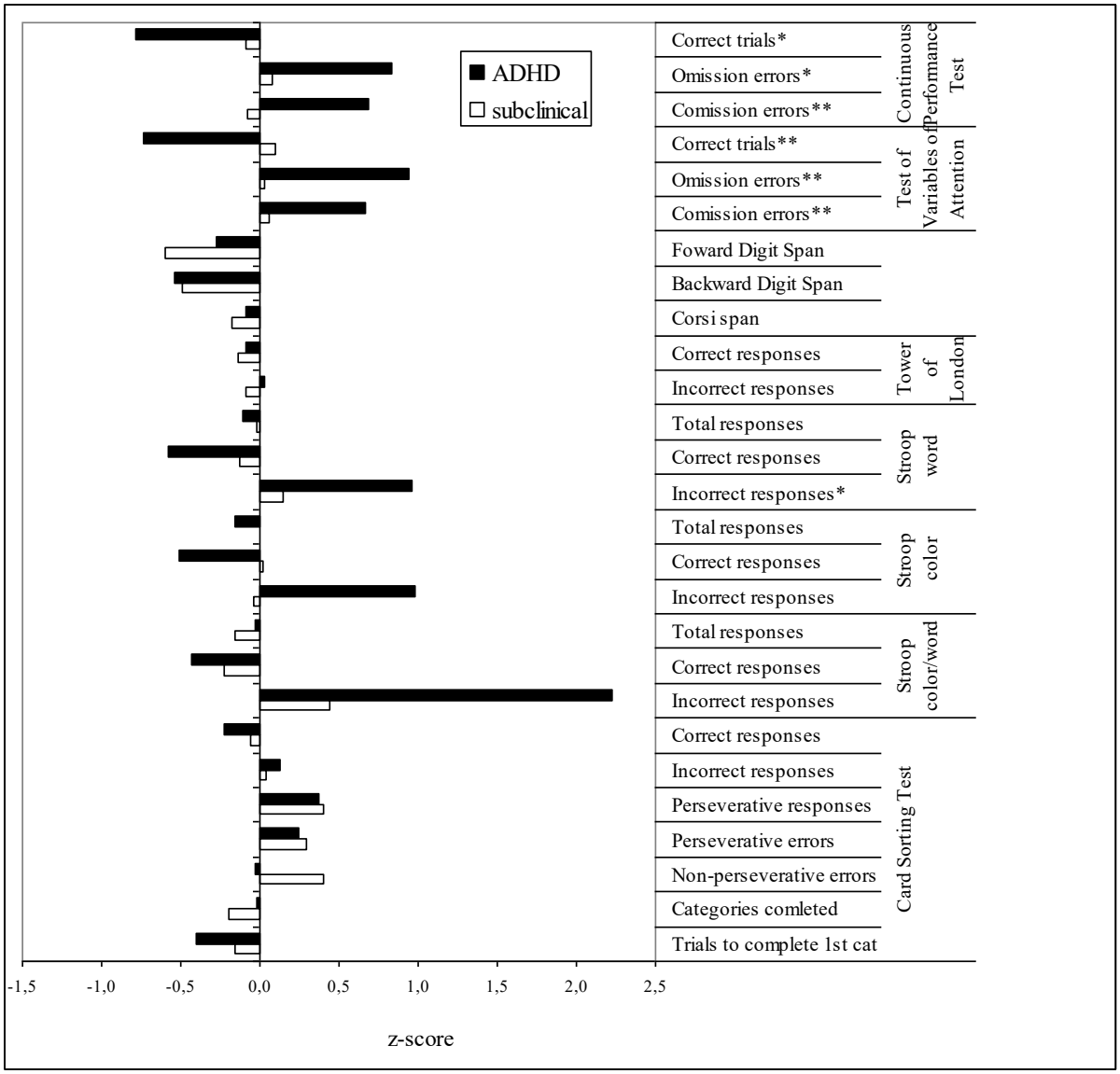
*p<0.05

Fig. 3. – *Clusteranalyse based groups comparison on WISC-IV index and subtests*

The results of the executive functions test

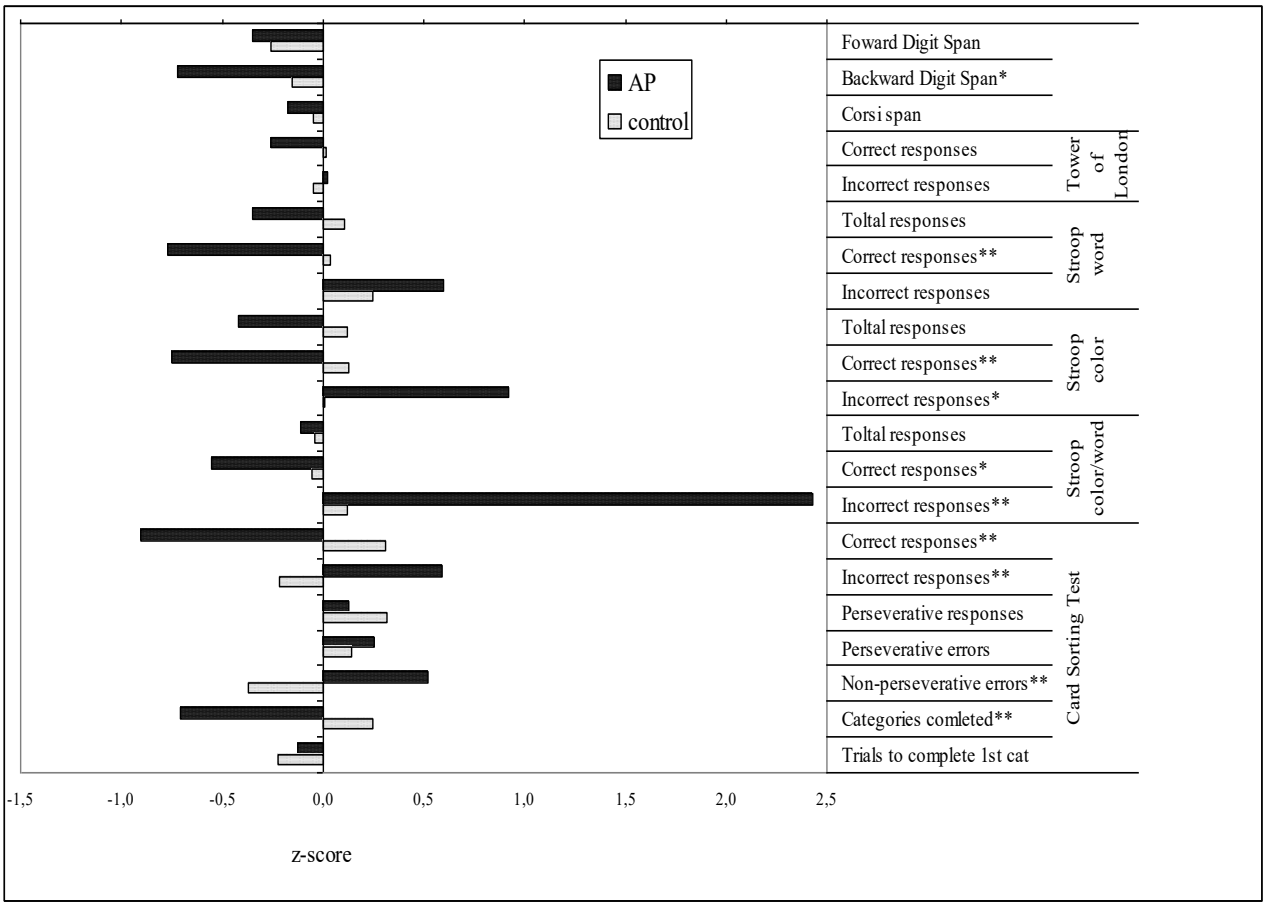
The executive function tests don't have Hungarian norms, so on the bases of control group average and standard deviation we transformed the results into z-scores (average: 0; standard deviation: 1).

Regarding the executive functions significant differences among the initially formed groups can be seen in the case of all the three variables (correct trails, omission errors, commission errors) of Continuous Performance Test and Test of Variables of Attention; significant difference can also be observed in the case of the errors made in the Stroop test's word reading (see Fig. 4.). The comparisons of the three groups indicated that ADHD groups performance was significantly altered compared to both the control group and the subclinical group, while the later two groups obtained statistically same results.



p<0.01; *p<0.05 **Fig. 4. – *Original group's comparison for executive functioning results*

Between the groups formed on the bases of clusteranalyse there can be seen significant differences in other executive functions as well. The attention problems group obtained significant lower achievement on response inhibition, problem solving, verbal working memory, until their performance was the same on planning, phonological short term memory and on visuospatial memory (see Fig. 5.).



p<0.01; *p<0.05 **Fig. 5. – *Clusteranalyse based groups comparison for executive functioning results*

Discussion

Regarding the intelligence test results

The results regarding the intelligence structure unequivocally falsify those earlier concepts that consider lower intelligence level ADHD specific (Frazier, Demaree and Youngstrom, 2004) or that along intelligence profile there could exist such group-specialties that could help differential diagnosis (Lufi, Cohen and Parish-Plass, 1990; Pineda, Ardila and Rosselli, 1999; Assesmany and mtsai., 2001; Mayes and Calhoun, 2006; Wechsler, 2008).

The results refer not only to children with ADHD but also to children having attention problems since there were no differences found regarding the intelligence structure – neither in the initially formed groups on the basis of original inclusive criteria nor in the groups formed on the bases of level of vigilance of attention – that could be a useful guide in differentiating children having attention problems (see Fig. 2. and Fig. 3.).

Our results support those earlier statements that consider the intelligence tests – although being an integral part of diagnostic and decision-making process – aren't suitable for diagnosing developmental disorders for more comprehensive understanding and for a more precise identification further developmental neuropsychological measures are needed (Weiss et al., 2008).

Regarding the executive functions results

Analyzing the performances achieved by originally formed groups it can be seen that people with ADHD having the same intelligence as typically developed children had the same results as the control groups children at behavior level in the executive functions test except vigilance (the high number of errors made in the Stroop-test can be connected to the impulsive responses and not to the executive functions deficit as shown by correlation

analyses). According to our results we could accept those concepts that reject the executive functions deficits in the case of ADHD (Jonsdottir et al., 2006; Di Trani et al., 2011). In our opinion it remains still an open question and to get a reliable answer further researches are needed regarding both the mechanism of brain and the behavioral characteristics.

The third main issues of our research is whether the conventional diagnosis established by psychiatrists and the results of the continuous performance tests measuring the vigilance of attention are or not identical. The results obtained are interesting on the one hand because the initially formed three groups were replaced by two groups, on the other hand because children from ADHD group were moved to the groups without attention problems moreover six children from the former control group were moved to the group of children with attention problems (see Fig. 1.).

These results seem to suggest that the attention problems could be grabbed more in categories than in a continuity on the other hand support those earlier statements according to which the rating scales results are less useful in determining the gravidity of the disorder (Takács, Kóbor and Csépe, 2010; Gathje, Lewandowski and Gordon, 2008). A previous Hungarian research based on a subclinical sample had similar results: when people were grouped according to their results in executive functions tasks the initially formed groups based on the attention scale of CBCL were considerably changed (Kóbor, Takács, Csépe, 2010).

According to the executive functions results it can be seen that children with attention problems show differences in several aspects compared to control group. In the case of children with attention problems besides the vigilance system seems to be affected the verbal working memory, response inhibition and planning ability as well.

Summering the results

However it seems that some of the issues remain still opened, analyzing the results opens new questions. How can the fact be explained that in the case of ADHD – except the vigilance – we didn't find any cognitive marker that could confirm the ADHD specific executive functions deficit, since between groups based on the results of vigilance tasks the executive functions deficits are evident. Explaining these results would be very palpable to criticize the methods for diagnosing disorders used in our country, not all children having an ADHD diagnosis are really affected. At the same time before dealing too seriously – maybe wrongly – we have to take into account the earlier consideration stating that executive functions disorders are neither necessary nor sufficient for ADHD's appearance (Willcutt et al., 2005) furthermore the executive functions test's results ranking in average domain don't exclude the presence of ADHD (Seidman, 2006). Barkley (2012) the worldwide famous expert states that the executive functions disorders are to be found at people having prefrontal disease even if tests cannot figure them out. Taking into consideration these it is possible that in the background of our results are not the false diagnosis but further new considerations are needed for the variances.

For explaining the results we have to take into consideration Sonuga-Barke's (2002) dual-pathway model and the differentiation of cool and hot aspects of executive functions.

Sonuga-Barke's (2002) conception about ADHD's occurrence is that the disorder can emerge due to two totally independent developmental courses while there is no difference in symptoms at behavioral level. According to one of his model's pathway the dysfunction of thoughts' and actions' control is due to inhibitory deficits' irregularity. It is linked to further disorders of cognitive functions. The other pathway can be linked to a motivational style where we meet the delay aversion (connecting behavioral manifestation, involvement into tasks and mechanism of reward); consequently future actions' values are more depreciated by children with ADHD compared to typically-developing people. Although the cognitive functions are not involved – dependent on the environmental conditions – the delay aversion

could be a result of preference for immediate reactions and this can cause impulsivity for example (Sonuga-Barke, 2002).

According to his model ADHD can be the result of the disorder of executive functions and motivational style and delay aversion as well. His conceptions are also supported by neuropsychological background, the two pathways suggested by him can be linked to different frontostriatal circuits (dorsal/ventral-orbitofrontal) that shares a lot of similar neuro-chemical and neuro-anatomical elements (Sonuga-Barke, 2003).

The "cool" aspect of the executive functions plays a significant role in the integration of cognitive processes, control and regulation direct and sustains the attention process and is responsible also for planning, organizing and working memory (Powell and Voeller, 2004). The "hot" aspect of the executive functions ensures the self-regulation by regulating the inhibition/stimulation (Schneider et al., 2006), it plays an important role in decision-making having an emotional base (Tárnok et al., 2006). Having in view these considerations in Sonuga-Barke's model (2002) the former aspect of executive functions could be linked to the executive functions disorder, while the latter one to the delay aversion.

In this regard people having executive functions disorder have problems regarding the "cool" aspect of executive functions while for delay aversion the "hot" aspect of executive functions is responsible.

Taking into consideration such a division of executive functions our study focused on the "cool" aspect of executive functions ignoring the "hot" aspect.

Taking into account that ADHD at behavioral level produces the same syndromes independently from the background's altered developmental course (Sonuga-Barke, 2002) and that psychiatrists diagnose on the bases of behavioral signs our results can be interpreted as follows. On the basis of inclusion criteria in our ADHD group could be included children with executive functions disorder and those with delay aversion as well. After clusteranalyse in the group with attention problems were included those children whose "cool" aspect of executive is impaired. There were 12 children who had initially ADHD diagnosis but after clusteranalyse were included in the group without attention problems. We suppose that their "hot" aspects of executive functions could be affected. We have to state that all these are only suppositions because we used no tasks measuring the "hot" aspect of executive functions. According to Sonuga-Barke model the ADHD could occur independently in both pathways (executive function disorder, delay avoid) but their common occurrence is not excluded as well so our suppositions need further researches taking into account the possible delay aversions as well (Sonuga-Barke, 2002).

This approach could explain the earlier contradictional results, too since in most of the researches as inclusive criteria clinical diagnosis of ADHD are used which don't enable us to define which aspect (cool/hot) of executive functions is impaired. Thus in researches – including our study – participate people with impaired functions of "cool" or "hot" aspect of executive functions too. We suppose that in those researches where the executive functions deficits are clearly to be seen were included those people with ADHD at a higher rate whose "cool" aspect of executive functions is impaired while in those researches which could not reveal the executive functions deficits were included those people with ADHD at a higher rate whose "hot" aspect of executive functions is impaired. The first analyses seemed to prove that earlier concept according to which the executive functions – except the attention component – are intact in the case of ADHD. But as soon as people supposed to have delay aversion and not executive functions deficits were excluded the executive functions deficits could be obviously observed.

It is obvious that in the case of ADHD there are a lot of open questions; at the same time it can also be seen that while trying to answer these questions instead of getting proper answers we have to face new ones and these lead to other uncertainty regarding ADHD. It is not a coincidence that in the DSM-V diagnostic manual a serious of possible restructures are emerged regarding the ADHD (APA, 2010).

In accordance with Band and Sheres's (2002) consideration according to which ADHD being heterogeneous is more complex to be grabbed with the help of one determinative so we think that in the future it will not be enough studying endophenotypes but other studies will be needed trying to reveal how these particularities form the different ADHD symptoms groups (Band and Sheres, 2005).

References

American Psychiatric Association (1994) *Diagnostic and statistical manual of mental disorders* (4th ed.), Author, Washington, DC

American Psychiatric Association (1995): *BNO-10 Zsebkönyv*, Animula, Budapest

American Psychiatric Association (2010) DSM-5: *Options being considered for ADHD*. http://www.dsm5.org/Pages/Default.aspx

Assesmany, A., McIntosh, D. E., Phelps, L., Rizza, M. G. (2001) Discriminant Validity of the WISC-III with Children Classified with ADHD. *Journal of Psychoeducational Assessment,* 19, 137 - 147

Band, G. P., Scheres, A. (2005) Is inhibition impaired is ADHD? *British Journal of Developmental Psychology,* 23, 517-523

Barkley, R. A. (2012) *Executive functions*. The Guildford Press, New York, London

Baron, I. S. (2004) Neuropsychological Evaluation of the Child. Oxford University Press.

Bass, L., Kő, N., Kuncz, E., Lányiné, Á., Mészáros, A., Mlinkó, R., Nagyné, I., Rózsa, S. (2008): *Tapasztalatok a WISC–IV Gyermek-intelligenciateszt magyarországi standardizálásáról.* Educatio Társadalmi Szolgáltató Kht, Budapest

Bell, A. S. (2010) A Critical Review of ADHD Diagnostic Criteria: What to Address in the DSM-V, *Journal of Attention Disorders*, X, 1–8.

Berger, A., Kofman, O., Livneh, U., Henik, A. (2007) Multidisciplinary perspectives on attention and the development of self-regulation. *Progress in Neurobiology*, 82, 256-286.

Crinella, F. M., Yu, J. (2000) Brain Mechanism and Intelligence. Psychometric g and Executive function. *Intelligence,* 27*,* 229-327.

Csépe V. (2005) *Kognitív fejlődés-neuropszichológia*. Gondolat kiadó, Budapest

Di Trani, M., Pia Casini, M., Capuzzo, F., Gentile, S., Bianco, G., Menghini, D., Vicari, S. (2011) Executive and intellectual functions in attention-deficit/hyperactivity disorder with and without comorbidity. *Brain & Development,* 33, 462-469.

Durston, S., Tottenham, N. T., Thomas, K- M., Davidson, M. C., Eigsti, I., Yang, Y., Ulug, A. M., Casey, B. J. (2003) Differential Patterns of Striatal Activation in Young Children with and without ADHD. *Biol Psychiatry*, 53, 871-878.

Frazier, T. W., Demaree, H. A., Youngstrom, E. A. (2004) Meta-Analysis of Intellectual and Neuropsychological Test Performance in Attention-Deficit/Hyperactivity Disorder. *Neuropsychology,* 18, 543-555.

Gathje, R. A., Lewandowski, L. J., Gordon, M. (2008) The Role of Impairment in the Diagnosis of ADHD. *Journal of Attention Disorders*, 11, 529-537.

Graham, J., Seth, S., Coghill, D. (2007) ADHD. *Medicine,* 35, 181-185.

Holdnack, J.A., Weiss, L. G., Entwistle, P. (2006) Advanced WISC-IV and WISC-IV Integrated Interpretationin Contex twith Other Measures. In Weiss et al. (eds.) *WISC-IV Advanced Clinical Interpretation,* Academic Pres of Elsevier, San Diego

Holmes, J., Gathercole, S. E., Place, M., Alloway, T. P., Elliott, J. G., Hilton, K. A. (2010) The Diagnostic Utility of Executive Function Assessments in the Identification of ADHD in Children. *Child and Adolescent Mental Health,* 15, 37-43.

Jepsen, J. R., Mortensen, E. L. (2008) Do Attention Deficits Influence IQ Assessment in Children and Adolescent With ADHD? Journal of Attention Disorders, 12, 551-562.

Johnson, T. M. (1997) Evaluating the hyperactive child in your office: Is it ADHD? *American Family Physician,* 56*,*155-161.

Jonsdottir, S., Bouma, A., Sergeant, J. A., Scherder, E. J. A. (2006) Relationships between neuropsychological measures of executive function and behavioral measures of ADHD symptoms and comorbid behavior. *Archives of Clinical Neuropsychology,* 21, 383–394.

Kóbor A., Takács Á., Csépe V. (2010) A végrehajtó funkciók neuro-pszichometriai perspektívából. *Pszichológia,* 30, 233-252

Lufi, D., Cohen, A., Parish-Plass, J. (1990) Identifying ADHD with the WISC-R and the Stroop-Color and Word test. *Psychology in the Schools,* 27, 28-34.

Mayes, S. D., Calhoun, S. L. (2006) WISC-IV and WISC-III Profiles in Children With ADHD. *Journal of Attention Disorders,* 9, 486 – 493.

Mueller, S. T. (2012) PEBL: The psychology experiment building language (Version 0.12) [Computer experiment programming language]. Retrieved Nov. 2012 from http://pebl.sourceforge.net.

Naglieri, J. A., Goldstein, S., Delauder, B. Y., Schwebach, A. (2005) Relationships between the WISC-III and the Cognitive Assessment System with Conners' rating scales and continuous performance tests. *Archives of Clinical Neuropsychology,* 20, 385-401.

Pasini, A., Paloscia, C., Alessandrelli, R., Porfirio, M. C., Curatolo, P. (2007) Attention and executive functions profile in drug naive ADHD subtypes. *Brain & Development,* 29, 400-408.

Pineda, D., Ardila, A., Rosselli, M. (1999) Neuropsychological and behavioral assessment of ADHD in seven to twelve-year-old children: A discriminant analysis. *Journal of Learning Disabilities,* 32, 159-174.

Powell, K.B., Voeller, K. K. (2004) Prefrontal Executive Function Syndromes in Children. *J. Child Neurol.,* 19, 785-797.

Rózsa, S., Gádoros, J., Kő, N. (1998). *A Gyermekviselkedési Kérdőív*. ELTE. Belső Kiadvány.

Rubia, K. (2011) "Cool" Inferior Frontostriatal Dysfunction in Attention-Deficit/Hyperactivity Disorder Versus "Hot" Ventromedial Orbitofrontal-Limbic Dysfunction in Conduct Disorder: A Review. *Biol Psychiatry,* 69, 69-87.

Scheres, A., Oosterlaan, J., Geurts, H., Morein-Zamir, S., Meiran, N., Schut, H., Vlasveld, L., Sergeant, J. A. (2004) Executive functioning in boys with ADHD: primarily an inhibition deficit? *Archives of Clinical Neuropsychology,* 19, 569–594.

Schneider, M., Retz, W., Coogan, A., Thome, J., Rösler, M. (2006) Anatomical and functional brain imaging in adult attention-deficit/hyperactivity disorder (ADHD) – A neurological view. *Eur. Arch Psychiatry Clin Neuroscience,* 256, 32-41.

Schuck, S., Crinella, F. (2005) Why children with ADHD Do Not Have Low IQ-s. *Journal of Learning Disability,* 38, 262-280.

Sciutto, M. J., Terjesen, M. D., Frank, A. S. (2000) Teacher's knowledge and misperceptions of attention deficit/hyperactivity disorder. *Psychology in the schools,* 37, 115-123.

Seidman, L. J. (2006) Neuropsychological functioning in people with ADHD across the lifespan. *Clinical Psychology Review*, 26, 466-485.

Sonuga Barke, E. J. S. (2003) The dual pathway model of ADHD: an elaboration of neuro-developmental characteristics. Neuroscience and Biobehavioral Review, 27, 593-604.

Sonuga-Barke, E. J. S. (2002) Psychological heterogeneity in AD/HD – a dual pathway model of behavior and cognition. *Behavioral Brain Research,* 30, 29-36.

Swanson, J. M., Sergeant, J. A., Taylor, E., Sonuga-Barke, E. J. S., Jensen, S., Cantwell, D. (1998) Attention-deficit hyperactivity disorder and hyperkinetic disorder. *Lancet,* 351, 429-434.

Takács Á., Kóbor A., Csépe V. (2010) Zavarok a diagnózisban? A figyelmi atipikusság „intuitív diagnosztikája" és neuropszichológiai profilja. *Pszichológia,* 30, 253-271

Tárnok Zs., Barsi P., Gádoros J., Halász P. (2006) Végrehajtó funkciók zavara frontális károsodásokban és frontális epilepsziában. *Ideggy. Szemle,* 59, 269–280.

Tehrani-Doost, M., Goodrezi, R. R., Sepasi, M., Alaghband-Rad, J. (2007) Executive Dysfunction in Children and adolescents with Attention Deficit Hyperactivity Disorder (ADHD). *Iranian J Psychiatry,* 2, 25-29.

Wechsler, D. (2008) *WISC-IV Technikai és értelmező kézikönyv*, OS Hungary Tesztfejlesztő KFT, Budapest.

Weiss, L. G., Beal, A. L., Saklofske, D. H., Alloway, T. P., Prifitera, A. (2008) Interpretation and intervention with WISC-IV in the clinical Assessment Context. In: PRIFITERA ET AL. (ed.): *WISC-IV Clinical Assessment and Intervention*, Academic Pres of Elsevier, San Diego

Willcutt, E. G., Carlson, C. L (2005) The diagnostic validity of attention-deficit/hyperactivity disorder. *Clinical Neuroscience Research,* 5, 219-232.

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., Pennington, B. F: (2005) Validity of the Executive Function Theory of Attention Deficit/Hyperactivity Disorder: A Meta-Anatytic Review. *Biol Psychiatry,* 57, 1336-1346.

Williams, L. M., Hermens, D. F., Thein, T., Clark, C. R, Cooper, N. J., Clarke, S. D., Lamb, C., Gordon, E., Kohn, M. R. (2010) Using brain-based cognitive measures to support clinical decisions in ADHD.) *Pediatric neurology,* 42*,* 118-26.

Publications related to the topic of the dissertation

Szabó Csilla, Mohai Katalin (2013) *ADHD-s és diszlexiás kisiskolás tanulók intelligenciaprofiljának összehasonlító vizsgálata (*Magyar Pszichológiai Szemle, 68, 223-244.

Szabó Csilla, Vámos Éva. (2013) *A figyelemzavar és hiperaktivitás (ADHD: Attention Deficit and Hyperactivity Disorder) diagnosztikai gyakorlata a sajátos nevelési igény megállapításában,* In. Torda Ágnes (alkotószerk.*) Diagnosztikai kézikönyv.* Educatio Társadalmi Szolgáltató Nonprofit Kft., Budapest, megjelenés alatt

Mohai Katalin, Szabó Csilla (2012). *Kognitív és viselkedési találkozási pontok fejlődési diszlexia és ADHD esetén.* A Magyar Pszichológiai Társaság XXI. Országos Tudományos Nagygyűlése, Szombathely, előadás

Mohai Katalin, Szabó Csilla (2011). *ADHD-t és olvasási zavart mutató kisiskolás tanulók intelligenciaprofiljának összehasonlító vizsgálata (Comparative examination of the intelligence profile of school children with ADHD and dyslexia)*. Magyar Pszichológiai Társaság Jubileumi XX. Országos Tudományos Nagygyűlése, Budapest, előadás

Mohai Katalin, Szabó Csilla. (2011) *Diszlexia és ADHD. Kapcsolódások és különbözőségek az intelligenciaprofil mentén.* „Officinae Bárczii" Magyar Tudomány Ünnepe, poszter

Szabó Csilla (2009): *Implicit/explicit folyamatok figyelemzavaros és hiperaktív (ADHD-s) és olvasási zavarral küzdő gyermekeknél*. Gyógypedagógiai Szemle, 37, 321-330.

Szabó Csilla, Poszet Emese, Veress Anabella (2007) *A figyelemzavaros-hiperaktív és tipikusan fejlődő gyermekek kognitív profiljának összehasonlítása.* Pszichológia*,* 4, 311-332.

Szabó Csilla (2004) *A figyelemzavaros és a hiperaktív gyermekek kognitív figyelemfejlesztésének vizsgálata.* Erdélyi Pszichológia Szemle*,* 2*,* 163-184.

Poszet Emese, Szabó Csilla, Veress Anabella (2003). *Hiperaktív és figyelemzavaros gyermekek differenciált diagnózisa.* XXVI OTDK, előadás